



# 44<sup>th</sup> INTERNATIONAL CHEMISTRY OLYMPIAD

## UK Round 1 - 2012

### MARK SCHEME

| Question | 1 | 2  | 3  | 4  | 5  | Total |
|----------|---|----|----|----|----|-------|
| Mark     | 9 | 14 | 17 | 23 | 17 | 80    |

| Question 1 |       |                                                                                                                                                                                                                                                                                                                                                  |  |  |       |
|------------|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|-------|
|            |       | Answer                                                                                                                                                                                                                                                                                                                                           |  |  | Marks |
| a)         | (i)   | Breaking bonds in 8 moles of $S_7$ (g): $8 \times 7 \times 260.0 \text{ kJ mol}^{-1} = 14560.0 \text{ kJ mol}^{-1}$<br>Making bonds in 7 moles of $S_8$ (g): $7 \times 8 \times 263.3 \text{ kJ mol}^{-1} = 14744.8 \text{ kJ mol}^{-1}$<br>Enthalpy change of reaction = $(14560.0 - 14744.8) \text{ kJ mol}^{-1} = -184.8 \text{ kJ mol}^{-1}$ |  |  | 1     |
| b)         | (i)   | <b>Amount <math>S_7</math></b> = $0.0076 \text{ g} / (7 \times 32.06) \text{ g mol}^{-1} = 3.387 \times 10^{-5} \text{ mol}$<br><b>Amount <math>S_8</math></b> = $0.9892 \text{ g} / (8 \times 32.06) \text{ g mol}^{-1} = 3.857 \times 10^{-3} \text{ mol}$                                                                                     |  |  | 1     |
|            | (ii)  | $K_c = [S_8]^7 / [S_7]^8$                                                                                                                                                                                                                                                                                                                        |  |  | 1     |
|            | (iii) | <b>Value for <math>K_c</math></b> $[3.857 \times 10^{-3}]^7 / [3.387 \times 10^{-5}]^8 = 7.34 \times 10^{18}$<br>(Ignore any units)<br>(allow error carried forward from part b(i))                                                                                                                                                              |  |  | 1     |
| c)         | (i)   | $\Delta_r H^\ominus(298 \text{ K}) = (-296.8 - (-297.1)) \text{ kJ mol}^{-1} = (+)0.3 \text{ kJ mol}^{-1}$                                                                                                                                                                                                                                       |  |  | 1     |
|            | (ii)  | <b>The most stable form is orthorhombic</b><br>Allow monoclinic if the answer given in c(i) is negative                                                                                                                                                                                                                                          |  |  | 1     |
| d)         |       |                                                                                                                                                                                                                                                                                                                                                  |  |  | 1     |
| e)         |       |                                                                                                                                                                                                                                                                                                                                                  |  |  | 1     |
| f)         |       | or            or either in reverse order                                                                                                                                                                                                                                                                                                         |  |  | 1     |